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ABSTRACT

This digest explains how the study of watersheds can serve to connect concept and skill development across subject areas and grade levels for curriculum reform and standards-based assessment. Specific resources are organized into watersheds in the curriculum, connections to National Standards, watershed concepts and activities, watershed education programs and materials, and watershed resources on the Web. (MM)

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By

David L. Haury

December 2000

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Digest

Studying Watersheds: A Confluence of Important Ideas

David L. Haury

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How is life in your watershed? Though we generally describe where we live in terms of towns, cities, or school districts, we also live within the boundaries of local watersheds. Determined by the topography of a region rather than political boundaries, watersheds are areas of land defined by the flow patterns of rainwater or melting snow and ice. In general terms a watershed is a geographic area where all the water, sediments, and dissolved materials drain to a common outlet—a stream, river system, reservoir, underground aquifer, or other body of water. It can also be thought of as an area that "catches" water and routes it to a common basin, channel, or network of channels. Internationally, the term *catchment* rather than watershed is used to convey this idea.

Some watersheds are complex systems like the Everglades (Robinson, Robinson, & Lane; 1996), while others are simpler river systems. Together they supply the world's fresh water. Understanding these natural systems and sustaining environmentally healthy conditions within these systems require the application of knowledge and skills from many subject domains, as well as active inquiry, collaborative study, and decision making. Unfortunately, most Americans do not know what watersheds are, and only 22% know that storm water runoff is the most common source of pollution in streams, rivers, and oceans (NEET, 1999).

Watersheds in the Curriculum

As the linked forces of curricular reform and standards-based assessment continue to delineate important ideas and skills to learn in science and other subjects, there is a growing need to identify focal points for organizing school programs. Locally relevant topics are needed to connect concept and skill development across subject areas and grade levels. A study of watersheds can serve this role; everyone on earth lives within a watershed; the quality of life is greatly affected by the condition of the local watershed; and watersheds can serve as an instructional focus for active learning in science, mathematics, social studies, environmental education, and other subject areas. Here are some examples (Cole-Misch, Price, & Schmidt, 1996):

- A watershed's geological history and hydrological processes teach elements of earth science.
- Analysis of the chemical and biological parameters of a river teaches *physical and biological sciences*.
- The gathering of quantitative, empirical data involves students in mathematics.
- Land and water use within a watershed provide a context for the *social sciences* in watershed management.

Furthermore, the study of watersheds provides the perfect forum for engaging community partners in the school curriculum. Many local issues relate to the supply and protection of drinkable water, and many occupations relate to monitoring and managing the environmental health of watersheds.

Connections to National Standards

Following are examples of how the study of watersheds intersects with the standards of selected subjects.

The *National Science Education Standards* (NRC, 1996) include statements about unifying concepts, skills of inquiry, and content knowledge that are relevant to the study of watersheds. Among the unifying concepts and processes explicitly mentioned is the concept of *systems*, a concept central to an understanding of watersheds. The *Standards* also emphasize engaging students in active inquiry, and the study of watersheds provides opportunity for both authentic, local inquiry and collaboration with others at a distance. Finally, the *Standards* refer to *science in personal and social perspectives*; a study of watersheds provides a unique opportunity to study issues related to water quality, water management, and community actions and policies.

Excellence in Environmental Education—Guidelines for Learning (K-12) (NAAEE, 1999) presents guidelines that emerge from six core principles which relate to a study of watersheds: (a) systems, (b) interdependence, (c) the importance of where one lives, (d) integration and infusion, (d) roots in the real world, and (e) lifelong learning. Guidelines are organized into four strands directly relevant to the study of watersheds: (1) questioning and analysis skills, (2) knowledge of environmental processes and systems, (3) skills for understanding and addressing environmental issues, and (4) personal and civic responsibility.

The *Principles and Standards for School Mathematics* (NCTM, 2000) present standards in ten knowledge domains, with several being particularly pertinent to the study of watersheds. Here is a sampling:

- Apply appropriate techniques, tools, and formulas to determine measurements.
- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.
- Develop and evaluate inferences and predictions that are based on data.

In the *Expectations of Excellence: Curriculum Standards for Social Studies* (NCSS, 1994), a set of ten thematically based curriculum standards are presented, the following seem most pertinent to a study of watersheds:

- *People, Places and Environments:* Students make informed and critical decisions about relationships between humans and the environment.
- *Science, Technology and Society:* Watersheds provide specific conditions and contexts for considering responses to societal issues related to science and technology.
- *Civic Ideals and Practices:* Examination and care of the local watershed provides an authentic forum for civic participation and personal involvement.

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Watershed Concepts and Activities

The study of water has traditionally been organized around specific resources—wetlands, ponds, rivers—or issues—pollution, water use, water quality—rather than within the context of a larger water system, the local watershed. The traditional approach creates awareness of water issues and facilitates development of skills and knowledge, but it fails to address the subtle, systemic, and chronic factors that influence the environmental health of watersheds. What is needed is a deeper understanding of the natural systems through which fresh water flows.

Study of watersheds has been encouraged, with varying emphasis placed on awareness (Vandas, 1997a, 1997b), protecting water resources (Jewett, 1996), and active exploration (Rainy day hike, 1995). Mattingly (1991) provided a rich context for thinking more broadly about watershed systems, and Milne and Etches (1996) provided a model to examine the dynamics of watersheds within classrooms. A high school guide (Gail, 1995) offers help in developing a program that includes community service. These ideas and activities provide excellent ways to examine aspects of watersheds, but more ideal would be ongoing attention to watersheds within curriculum frameworks.

Watershed Education Programs and Materials

The following programs and materials emphasize the opportunity for active investigations, integration of school subjects, and collaboration with other community partners.

Adopt-A-Watershed. This K-12, integrated, school-community program uses the local watershed to engage students in comprehensive studies of ecosystems, issues, and a broad range of science concepts. The curriculum matrix includes concepts, field studies, action projects, and community education activities for every grade level. For more information, see *www.adopt-a-watershed.org*.

The Rivers Project Curriculum was developed over several years through the efforts of several hundred high school teachers. Curriculum units include: *Rivers chemistry*, *Rivers geography*, *Rivers earth science*, *Rivers biology*, *Rivers language arts,* and *Rivers mathematics*. These supplementary materials help teachers incorporate field studies, classroom activities, and community resources related to watersheds within their traditional courses. For more information, visit the Website at *www.siue.edu/OSME/river*.

Earth Force – Global Rivers Environmental Education Network. This interdisciplinary watershed education and action program incorporates hands-on, scientific learning with civic action for young people. Program participants assess the health of their local watershed and develop a sustainable plan to improve water quality in their community. For more information see *www.earthforce.org/green*.

Give Water A Hand is a national watershed education program designed to involve young people in local environmental service projects. For more information, visit the Website at *www.uwex.edu/erc/gwah*.

Watershed Resources on the Web

Surf your watershed (www.epa.gov/surf) is provided by the U.S. Environmental Protection Agency and enables you to locate local watersheds and monitor conditions.

River network (www.rivernetwork.org) aims to help people understand, protect and restore rivers and their watersheds.

The World's Water(www.worldwater.org/links.htm) offers information and data on organizations and individuals who are cleaning up their watersheds.

U.S. Geological Survey Water Resources (water.usgs.gov/education.html) offers links to data, pictures, maps, and interactive sites related to water.

For More Information

Search the ERIC Database (*ericir.syr.edu/Eric*) for more resources related to watersheds. For best results, use *watersheds* as an identifier in your search strategy. To locate more watershed education resources on the World Wide Web, use a search engine, such as Google (*www.google.com*) and use the following search terms: watershed or watersheds education. For more information about Websites providing water information and data, please see Katz and Thornton (1997).

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